DRAFT
Changes may occur. Final version to be published on BSPC website soon.

Eutrophication of the Baltic Sea

BSPC 2019
Saara-Sofia Sirén
Member of Parliament
Parliament of Finland

The Baltic Sea Parliamentary Conference (BSPC) was established in 1991 as a forum for political dialogue between parliamentarians from the Baltic Sea Region. BSPC aims at raising awareness and opinions on issues of current political interest and relevance for the Baltic Sea Region. It promotes and drives various initiatives and efforts to support a sustainable environmental, social and economic development of the Baltic Sea Region. It strives at enhancing the visibility of the Baltic Sea Region and its issues in a wider European context. BSPC gathers parliamentarians from 11 national parliaments, 11 regional parliaments and 5 parliamentary organisations around the Baltic Sea. The BSPC thus constitutes a unique parliamentary bridge between all the EU- and non-EU countries of the Baltic Sea Region.

BSPC external interfaces include parliamentary, governmental, sub-regional and other organizations in the Baltic Sea Region and the Northern Dimension area, among them CBSS, HELCOM, the Northern Dimension Partnership in Health and Social Well-Being (NDPHS), the Baltic Sea Labour Forum (BSLF), the Baltic Sea States Sub-regional Co-operation (BSSSC) and the Baltic Development Forum.

BSPC shall initiate and guide political activities in the region; support and strengthen democratic institutions in the participating states; improve dialogue between governments, parliaments and civil society; strengthen the common identity of the Baltic Sea Region by means of close co-operation between national and regional parliaments on the basis of equality; and initiate and guide political activities in the Baltic Sea Region, endowing them with additional democratic legitimacy and parliamentary authority.

The political recommendations of the annual Parliamentary Conferences are expressed in a Conference Resolution adopted by consensus by the Conference. The adopted Resolution shall be submitted to the governments of the Baltic Sea Region, the CBSS and the EU, and disseminated to other relevant national, regional and local stakeholders in the Baltic Sea Region and its neighbourhood.

Table of contents

List of abbreviations

BSAG	Baltic Sea Action Group
BSAP	Baltic Sea Action Plan
BSPC	Baltic Sea Parliamentary Conference
BSR	Baltic Sea Region
ECA	European Court of Auditors
EUSBSR	European Union Strategy for the Baltic Sea Region
HELCOM	Baltic Marine Environment Protection Commission Helsinki Commission
NDEP	Norther Dimension Environmental Partnership

1 INTRODUCTION

The Baltic Sea is one of the most vulnerable seas in the world. It is a young, small, stressed and sensitive ecosystem. The sea is very important to all coastal states located at the drainage basin. The condition of the Baltic Sea effects not only our natural heritage, but the wellbeing, livelihood and health of the 85 million people living around the sea.

However, it is the making of us humans which has caused dramatical environmental load and pressure to the Baltic Sea. From an economic point of view, the condition of our waters can be seen as a market failure affecting people's lives. This makes water pollution in fact an external cost which requires actions from the government.

Eutrophication of the Baltic Sea is not a new topic. For example, Baltic Marine Environment Protection Commission - Helsinki Commission (HELCOM), has been researching and working on protection of the Baltic Sea already for four decades. Various programs, strategies and agreements have been committed to throughout the years (some of them presented in chapter 3.3.1). Despite all of them, the Baltic Sea still suffers from eutrophication (see e.g. HELCOM State of the Baltic Sea holistic assessment 2011–2016).

So why is it that we fail repeatedly to meet the standards that we have set together? To start with, the sea is very sensitive. Even though we have now, to some extend, been successful in decreasing nutrient input, the Baltic Sea has faced external load for decades. It will take time for the sea to recover. Furthermore, I believe that one of the main reasons could be the fact that political perspective is too short. To understand the future of the Baltic Sea, a wider perspective would be needed. Political decision-making could benefit from future oriented research and long-perspective visions.

Political decision-makers are not the only ones lacking long-time perspective. It has been shown, that eutrophication is a subject of public discussion in the summer time, when blue-green algal is visible in coastal areas. After the algal disappears when autumn comes, the topic disappears from the media too.

This report focuses in the possibilities that circular economy has in decreasing nutrient flows that cause eutrophication. The viewpoint is on international co-operation between countries and areas that share the sea or are located around the drainage basin.

The main aim of this report can be summarized to one question: *How could international policy linked to Circular Economy affect eutrophication of the Baltic Sea in the future?*

For this report, this question was approached through two futures studies methods: horizon scanning and morphological analysis. To clarify the ideal situation and worst case scenario, future scenarios were formed based on analysis. Scenarios show how financial difficulties can lower the importance of environmental topics both in the eyes of decision-makers and people in general. This may be shown in the number of investments made, in the level of ambition in strategies and legislation, as well as in the attitudes and requirements of citizens.

Circular economy could reduce nutrient loads from agriculture and decrease eutrophication in the Baltic Sea. There is great potential for example in nutrient recycling. International cooperation and policy play a key role in the protection of the Baltic Sea. However, countries around the Baltic Sea are different and have different situations.

There are numerous strategies, programs and commitments related to eutrophication of the sea. The challenge is in implementing set targets on a national level. Legislative structures should support adopting sustainable ways of thinking and the idea of circular economy. This, however, would require restructuring of legislation related to, for example, agricultural subsidy mechanisms.

Much work still lies ahead of us in ensuring that our children will have an opportunity to enjoy and sustainably benefit from the Baltic Sea. Climate change and global warming will only make the situation more challenging.

This report serves as an overview of eutrophication and circular economy in the Baltic Sea area. It is based on my Master thesis in the field of Futures studies (University of Turku, 2018). My previous BSPC report regarding eutrophication was published at the annual conference in 2017.

Saara-Sofia Sirén

Member of Parliament, Parliament of Finland

BSPC Rapporteur on Eutrophication

1.1 Eutrophication and Circular Economy

The most serious environmental problems at the Baltic Sea are caused as a result of eutrophication. A lot of efforts have been taken place to improve the situation; however, we have not been successful in restoring the waters to good condition. Even though the amount of phosphorus and nitrogen has decreased, the Baltic Sea is still affected by eutrophication. For example, the condition of three quarters of Finnish coastal waters is weakened.

The subject of eutrophication at the Baltic Sea has been researched quite widely. Most of the research has been focusing on the history and current situation of the Baltic Sea. Although research concerning eutrophication of the Baltic Sea has been taken place already in the 80s and 90s, the topic is continually researched. For example, HELCOM collects data regularly. The latest State of the Baltic Sea –report was published last year (HELCOM 2018).

At the moment the condition of the Baltic Sea is under wide interest in many Baltic Sea states, especially the Nordic countries. For example, Baltic Sea Centre of Stockholm University has a team of scientists (Baltic Eye) working independently on research regarding the Baltic Sea, with eutrophication as one focus of their research. The aim of their work is to bridge the gap between the extensive research conducted and the policy-making of the Baltic Sea Region.

In this report, I am interested in the possibilities that circular economy has in decreasing nutrient flows that cause eutrophication in the Baltic Sea. Circular economy is an economic model where added value is created through a smarter way of doing things. In circular economy, the focus is in reusing materials and in creating as little as possible, if any, waste.

This is also the idea of nutrient recycling in agriculture. Eutrophication is mainly caused by nutrients such as phosphorus and nitrogen. In the past the nutrients have been from several causes. Biggest decrease has taken place in sewage treatments of both industries and households. Today, the biggest potential in decreasing nutrient flow is in agriculture. Even though technologies have improved a lot, phosphorus and nitrogen are not always used effectively in agricultural systems, whereupon nutrient flows may end in waters.

1.2 Political topicality

Wellbeing of the Baltic Sea has been a political topic for decades, especially since the founding of HELCOM in 1974. Eutrophication and circular economy are mentioned as topics for example in the Circular Economy Strategy of the European Commission.

The exceptionally warm summer of 2018 lead to vigorous blooming of blue-green algae all around the Baltic Sea. This further boosted the political discussion regarding eutrophication and circular economy.

1.2.1 Topicality on EU level

As several countries share the Baltic Sea, international co-operation is vital for decreasing eutrophication of the sea. International documents such as the EU Marine Strategy, the Baltic Sea Action Plan of the Baltic Marine Environment Commission and the EU Strategy for the Baltic Sea Region create the framework for political decision-making regarding the Baltic Sea and thus form a basis for the activities of improving the condition of the Baltic Sea. These documents are further introduced in chapter 2.3.1.

In the beginning of December 2015 European Commission published a new strategy for circular economy. This Circular Economy Package presents ambitious proposals addressing various sectors, including water policies and recycling of nutrients. The Circular Economy Strategy of the European Commission offers a timely frame of reference for this report. The package has a strong focus on waste management and recycling (especially plastics), however the communication "Action Plan for the Circular Economy" for example includes new regulation, which aims at encouraging recycling of nutrients.

In the HELCOM Ministerial Meeting in Brussels on 6th of March 2018, the Baltic Sea countries responsible Ministers and the EU Commissioners adopted the HELCOM Brussels Ministerial Declaration and agreed on new commitments for the Baltic marine environment, one of the main objectives being the updating of the Baltic Sea Action Plan.

The Baltic Sea Action Plan (BSAP), originally adopted by all the coastal states and the EU in 2007, aims for the good environmental status of the Baltic Sea by the year 2021. Two years remaining from the goal, there is a lot to be done. Therefore, the Ministerial Meeting of Brussels decided in March that the BSAP needs to be updated to include new measures to ensure that the existing goals are achieved. The participants of the meeting also committed to developing a Baltic-wide nutrient recycling strategy by 2020. This is an important step towards the Baltic Sea unaffected of eutrophication. The aim is to reduce the nutrient inflow to the sea and to ensure more efficient use of nutrients.

1.2.2 Topicality on the level of Baltic Sea Region

Baltic Sea Parliamentary Conference (BSPC) is a cooperation initiative between parliamentarians from national and regional parliaments as well as parliamentary organizations located around the Baltic Sea. BSPC was founded in 1991 with the aim of increasing dialogue and cooperation between parliament level politicians from different countries and regions surrounding the sea. What is special in the work of BSPC, is that is bridges BSR parliamentarians from both EU- and non-EU countries in a unique way.

The main event of BSPC is the yearly conference, which gathers together parliament representatives from all BSR states. The hosting state influences the head topics of each conference. In the previous years the discussion has been somewhat focusing on topics such as security, immigration, health and tourism within the BSR. However, in the BSPC conference in Mariehamn 2018, eutrophication of the Baltic Sea was mentioned in several speeches, even though it was not on the focus on the official agenda. Three reports related to the topic were presented in the seminar.

Wellbeing of the Baltic Sea was at the core also in the opening speech held by the President of Finland, Sauli Niinistö in Mariehamn. The President pointed out for the audience that the status of the Baltic Sea is not very good, especially after an exceptionally warm summer and extensive amount of blue-green algae blooming. The President reminded the representatives that throughout history, the Baltic Sea has served well the people living in the Baltic Sea region, and we must ensure that it will be able to do so in the future as well. The President mentioned climate change and eutrophication as the main concerns, and reminded that every nation, every parliament and every citizen must be involved in turning the course of development towards the goals of sustainable development and restoring a healthy marine ecology.

According to President Niinistö, a lot has been done to enhance the status of the Baltic Sea, but measures need to be further accelerated. The President pointed out in his speech the importance of measures such as reducing the nutrient load caused by human activity, such as agriculture, and reducing the amount of plastic waste coming to the sea. President Niinistö also underlined that the intergovernmental cooperation is vital in the process of protecting the marine environment of the Baltic Sea, and that the work of Helsinki Commission is an important cornerstone in achieving the goals.

Finland received the presidency of the Helsinki Commission for a two-year term. Also President Niinistö agreed, that the next important goal in HELCOM is to update the Baltic Sea Action Plan BSAP. The President also pointed out in his speech, that he warmly welcomes the idea that one day the Baltic Sea Region would become a model for sustainable development.

1.3 Aim of the report

The aim of this report is to give insight of the effects Circular Economy could have on eutrophication of the Baltic Sea by the year 2030. The viewpoint of this report is international, taking into consideration all Baltic Sea states and policy making structures within the Baltic Sea region.

The main aim for this report can be shown in one question:
How could international policy linked to Circular Economy affect eutrophication of the Baltic Sea in the future?

The question is limited to policy making within the Baltic Sea region. The future perspective is set to the probable end year of the new, yet to be updated HELCOM Baltic Sea Action Plan: 2030 (HELCOM Draft strategic plan for the BSAP update 2018).

2 SAVING THE BALTIC SEA… OR NOT?

2.1 The Baltic Sea

The Baltic Sea is a semi-enclosed sea and one of the largest brackish water basins in the world. It is located between Scandinavia and mainland Europe. The Baltic Sea is linked to the North Sea with a very narrow and shallow connection. This causes challenges in inflows of salt water and thus renewing the water masses.

Nine countries have coastline to the Baltic Sea: Finland, Sweden, Russia, Estonia, Latvia, Lithuania, Poland, Germany and Denmark. The catchment area is even wider, including states such as Belarus, Czech Republic, Norway, Slovakia and Ukraine. All in all, the Baltic Sea affects the lives of tens of millions of people.

Main threat to the Baltic Sea is eutrophication, which is caused by nutrients, especially nitrogen and phosphorus. Enrichment of nutrients leads to excessive growth of algal and plant. Almost the whole Baltic Sea is said to suffer from eutrophication. Much effort has been put into improving this situation; however, we have been unsuccessful in getting these waters back into good condition. The Baltic Sea is still affected by eutrophication, despite a decrease in the amount of phosphorus and nitrogen.

2.2 Circular economy

Circular economy, an economic model which involves creating added value through a smarter way of doing things, could provide an overall approach to achieving a healthier Baltic Sea. Expressed simply, circular economy is a way of doing things more intelligently, which has the potential to benefit all parties when done properly. This would pave the way for an entirely new business ecosystem with the potential to create new jobs, new merchandise, wellbeing, bigger harvests and a healthier Baltic Sea.

The European Commission Circular Economy package sets stricter targets for the use of natural resources and directs political decision-making towards achieving more sustainable outcomes. One example involves recycling nutrients from agriculture for reuse, rather than burdening the environment. Furthermore current government activities are also playing a major role in decreasing

eutrophication caused by nutrient loading. A concrete example of this can be seen in the recycling of nutrients from agriculture.

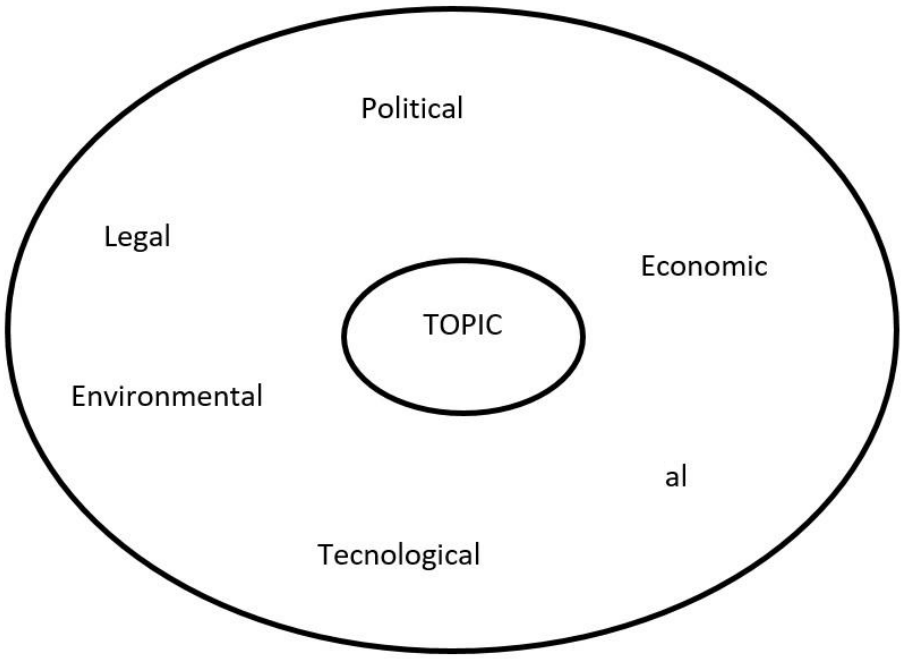
2.3 PESTEL analysis

An often-cited idea in Futures studies is that the future cannot be predicted – but alternative futures can (and should) be forecasted. Take for example eutrophication of the Baltic Sea. We would need to set a goal, a preferable future scenario of the ecological status of the sea, and then accordingly take a path of measures, which lead us towards this goal.

To have this kind of foresight, we would need to scan the environment and form an understanding of the current situation. Thus, to understand the status of the Baltic Sea from a wider perspective than just the numbers of algae growth, we would need a comprehensive view of the situation.

Eutrophication is not only an environmental question, but an economic and social question too. Furthermore, it has political, legal and technological aspects. These qualitative variables could form a strategic analysis.

PESTEL analysis is a tool used to identify and analyze external factors in strategic planning. There are various versions of the tool, but for this report I chose to use PESTEL, which categorizes political, economic, social, technological, environmental and legal factors effecting eutrophication of the Baltic Sea and possibilities of circular economy to prevent eutrophication.



Factors in PESTEL analysis

Figure above shows the factors analyzed through PESTEL. These factors are linked to several variables that all influence the topic at hand. The conditions of each factor also influence other factors. For example, changes in the policies conducted by governments (political and legal) can influence the economic situation. On the other hand, economic conditions affect political decisions and legislation. The variables of each factor affecting eutrophication of the Baltic Sea are further discussed in the next paragraphs. As the topic has an environmental emphasis, the environmental variables are discussed in more detail.

2.3.1 Political factors

International cooperation is vital to decreasing the eutrophication of the Baltic Sea.
Several international agreements, programs and commitments have been conducted throughout the years regarding the wellbeing of the Baltic Sea. On EU level, one of the key documents is Marine strategy framework directive. Another one is Water framework directive. One important document is the European Union Strategy for the Baltic Sea Region (EUSBSR). Saving the Baltic Sea is one of the three key aims of the strategy. All coastal states and the EU are committed to the HELCOM "Baltic Sea Action Plan" -program. Eutrophication has also been one of the main themes within Nordic co-operation. Wellbeing of the Baltic Sea is a topic also in the Norther Dimension Environmental Partnership (NDEP), however, lately the NDEP has not been active in topics relevant to this thesis. All these documents form a basis for the political discussion regarding eutrophication of the Baltic Sea.

The Baltic Sea Action Plan (BSAP) is an ambitious program adopted by the EU and all coastal states of the Baltic Sea in 2007. The plan aims to achieve a healthy Baltic Sea by the year 2021 and provides the basis for the work of HELCOM (the Helsinki Commission). To achieve the joint goal, set by the coastal states, for a healthier Baltic Sea, the Action Plan would have to be fully implemented on an urgent basis.

The EU Strategy for the Baltic Sea Region (EUSBSR) is an agreement between the EU member states and the Commission to deepen cooperation in the Baltic Sea region. The Strategy aims to improve cooperation between member states and to allocate funds to projects in the most beneficial manner possible. The overall goal of the Strategy is to solve the region's problems and take better advantage of existing opportunities.

The implementation of the EUSBSR is based on three objectives; 1. Save the sea, 2. Connect the region, 3. Increase prosperity. No funding has been allocated for the Strategy, but the idea is to align

existing funding with the jointly agreed actions and projects. The member states are cooperating on the implementation of the plan with the Commission, other member states, regional and local authorities, and inter-governmental and non-governmental bodies.

The European Union Marine Strategy Framework Directive requires that member states develop strategies to achieve a good environmental status by 2020. The aim of these strategies is to protect the marine environment and prevent any further damage caused by human activities. It underlines the need for cooperation between the countries involved. The EU Marine Strategy also requires member states to assess the environmental status of their marine waters, set targets and create a program, which includes various measures. Evaluation and monitoring are also required.

EU provides funding to Member States through several channels. As different research reports show, efforts to develop EU environmental compensation systems could have a major impact on the amount of emissions into waters. Such measures are viewed as important and cost-effective approaches to marine protection.

European Court of Auditors (ECA) conducted a special report "Combating eutrophication of the Baltic Sea: further and more effective action needed" in 2015. In its report, the ECA criticizes the lack of action taken by the EU Member States. Measures taken towards placing agriculture on a more sustainable basis are inadequate, given the pressure the sector is imposing on the Baltic Sea. More defined programs and effective measures are needed. The ECA also reminds that Member States are ultimately responsible for drawing up programs involving the actions necessary to cleaning up their waste waters.

Eutrophication is a major problem in the Baltic Sea and repairing the damage is a complex and time-consuming task. The results may become visible only after a long period of time. This should be taken in to account when evaluating strategies.

2.3.2 Economic factors

The worrying situation of the Baltic Sea can be seen as a market failure. The bad condition causes costs. The HELCOM report (2017) states that the total annual loss of benefits from eutrophication in the Baltic Sea region totals around 4,000 million euros. This shows how much the welfare of citizens living around the sea would increase if a better eutrophication status were achieved.

It has been calculated that decreasing eutrophication would bring economic benefits for the region worth of 3,6 billion euros. The benefits are greatly bigger than the costs of reducing nutrient load.

Water pollution can in fact be regarded as an external cost, which requires action from the governments concerned.

On the other hand, circular economy has hundreds of billions of market potential. Eutrophication of the Baltic Sea therefore has economic affects that go both ways: bad condition costs more than it would cost to fix the problem, plus the solutions enable significant possibilities for growth.

According to estimates by the Ellen MacArthur Foundation, on a global basis this represents an economic opportunity worth hundreds of billions dollars. Besides the environmental and social benefits of circular economy, Europe could further generate economic advantage worth of 1,8 trillion by the year 2030. A report by Club of Rome suggests that circular economy could create 75 000 new jobs by 2030 in Finland only. According to a study conducted by Gaia for Sitra, efficient nutrient cycle would create additional value in Finland 0,5 billion euros by the year 2030.

Our work towards creating a healthier Baltic Sea lacks implementation and targeting. Actions by Member States have resulted in only limited progress and investments have not been as effective as hoped. Between 2007 and 2013, the EU provided 4.6 billion euros in co-funding for waste water collection and treatment projects in the Member States. Funding towards agricultural development projects, including water protection programs, totalled 9.9 billion euros.

The European Court of Auditors report (2015) states that we are failing to achieve the related goals because the related measures are not targeted at the most problematic areas with respect to nutrient flows. Furthermore, the most polluting farms do not apply for agri-environmental schemes and funding, due to the limited compensation payments available. Also, Member States do not penalize offenders because the ‘polluter pays’ principle is difficult to apply to agriculture.

As part of the EU Marine Strategy Framework Directive, EU countries are required to control the cost-efficiency of any new measures taken. The cost-efficiency evaluation of measures taken to end the eutrophication of the Baltic Sea may not be reasonable in some cases. This observation was made in a report examining the cost-efficiency of measures taken under the Finnish marine strategy. Evaluating the effectiveness of measures is crucial, but the target year of the good condition of the sea (2020) and the expected results of the measures taken are hard to compare. The necessary investments are made now and the possible results are somewhere in the future. The full impact of the proposed measures will only be visible over a longer period of time. Estimating the cost-efficiency of the measures taken now is therefore hard if not impossible.

2.3.3 Social factors

The condition of the Baltic Sea effects not only our natural heritage, but the wellbeing, livelihood and health of the 85 million people living around the sea. Unfortunately, people do not always seem to understand the role of human actions in both causing and solving the situation. According to a survey by Swedish Environmental Protection Agency (2010), people living around the Baltic Sea have very varying attitudes regarding the status of the sea. The numbers differ from country to country, but in some countries less than half of people state that they are worried about the Baltic Sea environment. Eutrophication of the Baltic Sea has affects to the lives of all people living in the region, however, most people do not think that their own actions play a role in improving the status of the sea.

27% of Baltic citizens find the wellbeing of the Baltic Sea "extremely important". As many as 86% of Baltic citizens have not taken any action related to the wellbeing of the Baltic Sea. 23% state that they have plans to do so in the future.

On the other hand, people in nine Baltic Sea states value significantly the aim of achieving targets set in the Baltic Sea Action Plan – and are willing to pay for it. However, there are great differences between countries. Most willing to pay for a cleaner sea are people in Sweden, and least in Latvia.

2.3.4 Technological factors

Circular economy could be the solution to decrease the nutrition inflow that causes eutrophication. One key idea is to recycle nutrients from agriculture so that instead of the nutrients causing environmental load, they would be re-used. Multiple innovations based on the idea of re-using nutrients already exist.

There are projects bringing together research, decision-making and private funding with the aim of supporting eco-technologies with circular economy approach in the Baltic Sea region. For example, European Commission funded projects such as the Aquabest. One of the aims of this project was to find ways to "close the nutrient loop of Baltic Sea aquaculture through fish feeds based on regional ingredients" and another one to "create innovative concepts for land-based farms and transfer the technology throughout the region". The project was successful: such concepts were piloted and new technologies were developed and are now used.

Aquabest-project performed hands-on examples on how to increase aquaculture production without negative environmental effects. New regulation systems were suggested and partially

adopted, spatial planning process carried out, regional feed ingredients piloted and low-pollution farming technologies developed and implemented in new regions.

Another EU-funded project called “Bonus Return”, coordinated by the Stockholm Environmental Institute, has the aim of “turning nutrients and carbon from environmental problems into societal benefits in the Baltic Sea Region”. The project bases its work on research with the target of creating a market hub that produces eco-technologies.

Furthermore, there are various non-governmental organizations bringing different stakeholders together and working on the field of nutrient recycling. One example from Finland is the Baltic Sea Action Group (BSAG). Their nutrient cycling project develops on sustainable nutrient management and in creating a market for organic waste-based fertilizers. Another Finnish example is the NutriTrade -project by John Nurminen Foundation. The foundation has created an online platform for different stakeholders from around the Baltic Sea Region, to introduce different methods that could decrease nutrient flow.

2.3.5 Environmental factors

The condition of the Baltic Sea has changed dramatically during the last decades. As the sea is semi-enclosed, the sea suffers from lack of inflow of saltwater. The temperature of the deeper layers has also increased. All in all, the Baltic Sea has recently faced significantly dramatic changes.

One of the main causes for the current condition of the Baltic Sea is the inflow of nutrients. The two main nutrients affecting the sea are nitrogen and phosphorus. According to HELCOM’s Updated Fift Baltic Sea Pollution load Compilation (2015) total nutrient input in 2010 was 977 000 tons of nitrogen and 38 300 tons of phosphorus. If the numbers are normalized in terms of interannual variation and meteorology effects, the inputs are lower: 802 000 tons of nitrogen and 32 200 tons of phosphorus. The largest amounts of nutrients originate from three countries: Poland, Russia and Sweden.

We have some good news regarding the status of the Baltic Sea. Nutrient inputs to the Baltic Sea have, in fact, been reduced during the last decades. According to the HELCOM Baltic Sea pollution load compilation (2015), the amount of nitrogen input has fallen by more than 200,000 tons and phosphorus input by 7,000 tons per year.

However, eutrophication is still affecting the Baltic Sea, despite the fall in the amount of phosphorus and nitrogen. The nutrient input has not been decreasing as planned and a deterioration has occurred in the condition of three quarters of Finnish coastal waters, for example. Whereas

nutrient loads from urban agglomerations have been decreasing – mainly thanks to improved waste water systems – the nutrient load from agriculture has remained the same. In some countries, the nutrient load caused by agriculture has even increased. Agriculture is the main source of nitrogen and phosphorus that cause eutrophication.

According to HELCOM's Assessment of 2010, the environmental status of the Baltic Sea can be regarded as 'impaired' in general. Although steps have been taken towards reducing the nutrient input, only one or two areas of the Baltic Sea are currently unaffected by eutrophication.

The HELCOM report (2017) also states that point-source inputs of nitrogen and phosphorus to the Baltic Sea decreased by 60 percent and 68 percent between 1990 and 2000, and total inputs of nitrogen and phosphorus were reduced by 30 percent and 45 percent between 1990 and 2006. However, atmospheric nitrogen deposition may even have increased during the same period, making the net reduction much smaller.

HELCOM published the first version of its latest 'State of the Baltic Sea' report in July 2017, which provides scientific information regarding the environmental status of the Baltic Sea. Besides presenting an assessment of the current status and the pressures and impacts on the Baltic Sea marine environment, the report includes analyses of various social and economic impacts. The related data was prepared in close cooperation with Baltic Sea countries in 2015–2017. The timeline covered by the report is 2011 to 2015.

For the HELCOM report, the eutrophication status of the Baltic Sea has been evaluated using core indicators. These core indicators are still under development and some new ones have been added since the previous status report. The indicators assessed have been divided on the basis of three criteria: nutrient levels and the direct and indirect effects of eutrophication. The key findings of the report can be divided into three topics: 1) eutrophication, 2) hazardous substances and 3) biodiversity. In this report, I will focus only on the findings regarding the eutrophication of the Baltic Sea.

Eutrophication affects over 95 percent of the Baltic Sea region. In comparison to the previous HELCOM report, the eutrophication status has improved in two out of seventeen open-sea assessment units – whereas the situation has deteriorated in seven units.

The HELCOM report shows how net inputs of nitrogen and phosphorus into the Baltic Sea sub-basins have changed over recent years. There has been a significant reduction: nitrogen inputs have decreased by 13 percent in total and phosphorus inputs have decreased by 19 percent. Most remarkable is the reduction of phosphorus in the Gulf of Finland, where a change of 50 percent occurred between 1997–2003 and 2012-2014. The only increase in net inputs to sub-basins is a 3.2 percent increase in the phosphorus load into the Gulf of Riga.

However, despite falling nutrient loads from land areas, there has been no improvement in the Baltic Sea's environmental status in general, at least not yet. Positive outcomes may take time to appear. "Although signs of improvement can be seen in some areas, the effects of past and current nutrient inputs still predominate in terms of the overall status," the report states. According to the comprehensive report by HELCOM, the targets set in the Baltic Sea Action Plan will not be achieved on time. This is the case, despite improvements in management.

Indeed, it is worth noting that it may take time for the decreased amount of nutrients to appear in the overall condition of the Baltic Sea. It takes time for the changes to be seen in research measurements. As it has taken decades of nutrient flows to cause the current situation, it may take decades for the sea to recover from the eutrophication.

The ECA auditors visited Poland, Latvia and Finland, whereas questionnaires were sent to Sweden, Lithuania, Estonia, Germany and Denmark. The auditors found that, at the time of the inspection (2012), the input of nutrients was even higher in some cases than compared with the 1997–2003 average. Nitrogen inputs were higher in the case of Finland, Estonia, Lithuania and Latvia.

Expert bodies such as the Finnish Environment Institute believe that global climate change is affecting the climate in the northernmost parts of the world. Unfortunately, climate change will only worsen the problems caused and threats posed by eutrophication. Surface waters will become warmer as average temperatures rise, particularly during the summer. This will have multiple impacts, leading, for example, to further changes in the habitats and reproduction of species and organisms living in the Baltic Sea. Another predicted consequence is an even higher amount of rainfall, particularly during the winter months. As a result, the salinity level will decrease even further, intensifying the effects of eutrophication.

2.3.6 Legal Factors

In principle, international political agreements are not legally binding. For example, most of the European Union directives (such as the Marine strategy framework directive 2008) are not legally binding. Generally, directives are acts that set a goal or target, but the implementation is up to the individual countries. Recommendations neither have any legal consequences, if not followed.

On EU level there is not yet much legislation related to circular economy that would be directly linked to nutrients or wellbeing of waters. The directive proposals published so far consider mainly waste and packaging.

Much of the national legislation linked to the wellbeing of the Baltic Sea, is related to wastewater treatments. In Finland for example, the Environmental Protection Act provides the framework for treatment of waste waters.

In terms of agriculture, an effective means of control are the subside mechanisms. Farmers are payed special aid to support their production and especially its profitability. In order to receive this aid, farms need to make an environmental commitment. The content, monitoring and controlling of these commitments are therefore legislative means that could be used to foster nutrient recycling in agriculture.

3 RESULTS OF THE ANALYSIS

For this report I have used horizon scanning for collection of research material and for structuring it. As horizon scanning is an exploratory method, it has helped in giving an overall view of the topic at hand. The research material for this report consists mainly of official documents and international policy related to eutrophication of the Baltic Sea and circular economy as a means to decrease nutrient flow.

Morphological analysis was further used for analysis, discovering new relationships between parameters, and representing possible futures. As a normative method, it has provided suggestions regarding the future.

Based on these two Futures Studies methods, I formed four rough scenarios explained briefly in the next chapters.

3.1 Forming the scenarios

Scenarios can be described in many ways, but in general scenarios are seen as outlines or descriptions of possible futures based on a set of different variables and factors. Scenarios can be used for strategic planning in corporations and in public offices. They are especially useful in situations where decisions should be made in a changing and uncertain environment. Scenarios are helpful in picturing interactions between different factors and understanding the situation holistically, as they guide to consideration of several alternative futures.

The process of forming the scenarios for this report started with listing as many as possible variables under the drivers of PESTEL analysis as possible. I then selected the relevant variables based on the report material as well as my personal experience on the field of eutrophication and circular economy in the Baltic sea region.

In the following chapters scenarios of possible futures based on the morphological analysis are roughly introduced and explained. These four scenarios present different future paths formed from the various factors effecting the possibilities of circular economy in saving the Baltic Sea.

3.2 Admission to possibilities

The basis of this “green scenario” is in the emphasis of environmental topics. Economic growth creates space for environmental discussion and strengthens the importance of the wellbeing of Baltic sea both in the eyes of politicians and people in general.

As the economy is growing and the uncertainty in the Baltic Sea Region has decreased, concern regarding eutrophication attracts attention and realizes into political actions. The BSAP is updated with reasonable level of ambition, based on research data. Baltic Sea states and regions have open dialog with each other and share a view of an adequate target level, as well as necessary measures to decrease nutrient flows causing eutrophication. International targets are implemented on country level and politicians are committed to act in order to gain improvement in the condition of the Baltic sea. Furthermore, actions regarding climate change take place keeping the effects of global warming in control.

When concern about economy and security is not a prevalent factor in the overall atmosphere, general public is more receiving and better prepared to face, and even demand, changes that affect their personal lives. Also, as environmental topics are more often publicly displayed and discussed, people are more willing to make changes further in their own habits as residents and consumers.

This atmosphere shows also in the legislation processes, which lead to new restrictions concerning nutrient use in agriculture. This means for example, that a certain percentage of nutrients need to be recycled. On the other hand, legislation is modernized to support the idea of circular economy. This means more flexibility in, for example, treatment of waste and side streams of production. Furthermore, the subside mechanisms are modernized to support change towards circular economy. The starting point of the new structure for subsidies is to recognize environmental acts, functions and investments.

The change in attitudes and legislation further creates opportunities to exploit the market potential of circular economy. Circular economy is seen profitable from the perspective of environment as well as agriculture. Positive attention and enthusiasm attract financial investments as well as governmental contributions. Taking advantage of innovations related to recycling of nutrients creates costs on a short term. However, the improved condition of the Baltic Sea enables new market value. Experiments of new technology are in many places successful, best practices are distributed widely and nutrient flows are decreasing around the Baltic Sea region.

3.3 Future dominated by other things

The analysis of this path ("red scenario") starts from the economic and political aspects. As people are more interested in environmental topics during better economic times, a depression decreases the willingness to work towards the wellbeing of the Baltic Sea. Worry of the weakening economy leads to less ambitious targets in the updating of the Baltic Sea Action Plan. Uncertainty within the Baltic Sea region continues, which complicates the relation and cooperation between BSR countries. This happens especially in regard to countries such as Russia and Poland, which play a big role in nutrient flow from agriculture. The relation with Russia is further complicated through sanctions, which especially hamper cooperation around environmental topics.

This scenario is also the scenario of growing protectionism. As the competition in the international markets polarizes, turning inward and pursuing towards own interests also describes attitudes towards circular economy and saving the Baltic Sea. When countries stress benefits for themselves to the detriment of the common interest, shared targets are not implemented on country level. This implies further, that BSR countries do not value the condition of the sea and the condition decreases.

Due to uncertainty, economic depression and tightening atmosphere within the Baltic Sea region, the ecological condition of the Baltic Sea is not among the most important topics in political discussions. As often happens, topics related to economy and safety leave environmental aspects behind and the relations of these themes are not observed. Circular economy remains an important theme among politicians orientated towards sustainability and environmentalism in general. Uncertainty, doubt and the feeling of insecurity give rise to extensive demonstrations. Many of them are about economy and defense policy, some of environmental themes too. Nevertheless, the focus on national and international politics remains on other topics than those linked to sustainability.

The attitudes of politicians reflect those of the general public. People are not willing to change their own behavior – often not even when they would find saving the Baltic Sea an important target. Confrontation between different views strengthens. This shows also in the differing viewpoints between agriculture and nutrient flows to the waters. The possibilities of circular economy in creating mutual benefit are not understood.

In this scenario the potential of circular economy is not fully used. The idea of circular economy is not understood holistically throughout legislation processes, but rather limited to narrow single topics. Because of growing protectionism and with the aim of increasing growth of agriculture, restrictions concerning nutrients are decreased. This increases the use of nutrients in agriculture but does not increase the growth of the sector.

Due to economic downturn and lack of interest, there are not enough investments in research and development. Legislation does not provide possibilities or support to taking use of the potential of circular economy as a whole, nor recycling of nutrients as an example. Even though there are a few projects and experiment, the scale is small and best practices are not shared. Failures dampen the general interest and mood towards applications of circular economy.

The good development in nutrient flows and improvement in the condition of the Baltic Sea stops and increasing nutrient inputs aggravate eutrophication. At the same time climate change worsens the situation towards an environmental catastrophe.

3.4 Continuum of status quo

The "yellow scenario" is based on the idea of no major changes in the factors forming the future. The development of political atmosphere, economics and attitudes of people follow a stable path remaining somewhat unchanged and unsurprising. Even though there are no positive nor negative black swans, the overall development of the Baltic Sea is towards an un-preferred future scenario.

In this scenario many factors remain on an uncertain status. The economic situation remains unstable in terms of development of international markets (for example the relations between USA, EU and China). Whereas free trade agreements are achieved with some countries, import duties may occur with others. Economic growth slows down and investments to sustainability in general, and wellbeing of the Baltic Sea in particular, remain on a modest level.

International cooperation within the Baltic Sea region continues with emphasis on other issues rather than environmental topics. The BSAP is updated, however the challenges of the plan remain: targets are not based on biological facts, but rather on political compromises. Regarding implementation of the targets, the degree of commitment varies among countries. The Nordic countries take leadership of environmental topics on international forums, however, there is an ongoing discussion channel and some level of cooperation between all BSR countries.

The potential of circular economy arouses some enthusiasm, but the hopefulness is shown mainly on big words rather than actual openings. The focus of circular economy in practice is on other possibilities than recycling of nutrients. This is shown also in the number of financial investments. Even though there are promising outcomes from experiments and small-scale projects, these innovations do not wake up major attention or attract enough investors.

Saving the Baltic Sea is not a big question among the general public, nor do people demand stronger actions from the politicians regarding nutrient flows causing eutrophication. Prevailing

attitudes towards environmental impacts of agriculture are rather nonchalant and indifferent than contradiction and confrontation. Legislation on the matter remains the same, as does the structure of environmental subsidies to agriculture.

Therefore, nutrient flows to the Baltic Sea remain on approximately the same level. However, as climate change progresses and thus has major effects, the overall condition of the sea deteriorates.

3.5 Geopolitics, random coincidences and private saviors

Starting point of this "black scenario" is growing tension in the Baltic Sea region. Unstable political situation is shown especially in the relationship between the Nordic countries and Russia and Poland. The economy takes a downturn and international market remains unpredictive. Sanctions and market restrictions take place both ways making international cooperation difficult. Co-operative projects on protecting the Baltic Sea are put to hold, as is the updating of HELCOM BSAP.

This situation decreases the role and importance of environmental topics in the eyes of both the public and the decision-makers. As times are tense and uncertain, other topics, such as security, seem more relevant. There are no major changes in legislation related to waters, agriculture or circular economy in general.

Nevertheless, research is conducted, and new innovations based on the nutrition cycle are being commercialized. Private investors acknowledge the potential of Circular Economy and a wellbeing Baltic Sea. Thanks to private money increasingly flowing to the cause of preventing climate change and to protect the Baltic Sea, nutrition inflows and eutrophication are somewhat decreasing. However, the decrease is slowed down by static policy structures.

4 CONCLUSIONS

The status of the Baltic Sea remains alarming despite all the strategies, programs, commitments and funding implemented within the Baltic Sea Region since the 1980s. However, it is important to note, that there have been some improvements too. It takes time for actions to be shown in the wellbeing of the sea.

Eutrophication is still affecting the Baltic Sea, despite the fall in the amount of phosphorus and nitrogen. Global climate change will amplify the effects of nutrient load. The challenge is not getting any easier.

Eutrophication is a major problem in the Baltic Sea and repairing the damage is a complex and time-consuming task. The results may become visible only after a long period of time. Circular economy is not about repairing damage that has already been done. Programs and strategies would still be needed in order to reduce the eutrophication of the sea. However, circular economy could lead to adoption of a processes that would cause less harm.

In the previous chapter four alternative futures scenarios were presented:

"Green scenario": Potential of circular economy is utilized extensively. The nutrient flow to waters is decreased and therefore are also the impacts of eutrophication. Countries also take action regarding climate change and therefore global warming is stopped at a manageable level. Technology is developing and being used to an increasing extent. The Baltic Sea Action Plan is updated, and targets are set to a reasoned ambitious level. Baltic Sea states are implementing these targets on national level. Cooperation between BSR countries, including Russia and Poland, is intensifying. NGOs are closely involved in circular economy through funding and cooperation.

"Red scenario": This is the worst-case scenario, where the development regarding the condition of the Baltic Sea takes steps backwards. Climate change accelerates and worsens eutrophication at the same pace. The potential of circular economy is not exploited, as the intensifying political situation in the Baltic sea complicates cooperation between countries. Especially funding of environmental projects faces challenges due to political sanctions. The update of the BSAP comes to an end and fades. States and regions prioritize their own competitiveness at the expense of international benefit.

"Yellow scenario": This scenario is based on the continuum of the current situation. Locally the status of the Baltic Sea improves to some extent, based mainly on actions that have taken place previously. As the external load remains at the same level, eutrophication will continue, and climate change will make the situation even worse. Economic downturn leaves

environmental aspects with less attention and the concern regarding eutrophication is easily forgotten. Environmental non-governmental organizations however continue their work towards better wellbeing of the Baltic Sea and many pilot projects are successful. However, the potential of circular economy is only partly used. At the political level, the topic remains at the focus and activity of individuals.

"Black scenario": The fourth scenario is based on a more random selection of values for variables. For this scenario remarkable effect comes from geopolitical tension between countries. Together with challenges in the economy, the unstable international situation in the Baltic Sea region decreases the importance of environmental topics in political decision-making. However, private funding is directed into research, innovation and product development on the basis on circular economy. Privately funded and supported projects create business models for example for recycling nutrients and tackling climate change. However, decision-makers have their focus elsewhere and most citizens do not see need to change one's own behavior. Also, static policy structures and legislation do not support rapid change towards circular economy. Despite of this, private investments enable modest decrease in nutrient load to the Baltic Sea.

All four scenarios are scenarios of possible futures. Needless to say, from these four alternative futures scenarios, the green scenario, "Admission to possibilities", would be a preferred future.

Circular economy does indeed have great potential in reducing eutrophication of the Baltic Sea. At the same time, it could restore trust between environmentalists and the agricultural lobby on a 'win-win' basis, which will undoubtedly facilitate further cooperation. The technology to recycling nutrients in agriculture already exists. Renewing structures and legislation to support usage of such processes, would be useful in reaching the targets of decreasing eutrophication of the Baltic Sea.

As the Baltic Sea is surrounded with several countries and states, international policy is needed in order to protect the marine environment. The strategies and agreements that are committed to on a political level, should be based on latest environmental research and followed up regularly. Moreover, for the strategies to be successful, they would need to be fully implemented on a national level. This requires political stability and international cooperation, both of which become more challenging at times of economic depression.

4.1 Implications

Eutrophication, one of the main threats to the Baltic Sea, could be tackled by adopting the circular economy in legislative structures, international policy and therefore official acts, business practices and lifestyles of the tens of millions of people that live around the Baltic Sea. Difficulty is that effective and efficient utilization of the circular economy requires a new way of thinking. The change should be supported by legislative structures and international policy. A holistic understanding of circular economy would be needed in order to, for example, remodel critical legislation towards recycling of nutrients in agriculture. Subsequently taken measures, such as additional allocations of funding to reduce impacts of nutrients, are positive and necessary, and may reduce eutrophication on local level. However, a more sustainable, comprehensive and long-term solution would be to decrease the amount of nutrient flows in the first place. This, however, would require modernization of structures and policies.

For international policy to have significant effects on the wellbeing of the Baltic Sea, special focus should be put on national implementation of international agreements and strategies. It is further evitable that international relations, ways of cooperation and the overall economic situation greatly impact the possibilities for effective implementation of shared targets.

It is critical that agriculture is viewed as the solution rather than the problem. Both farmers and the environment could benefit from the circular economy and nutrient recycling. Mutual and enlightened self-interest forms the best way of engaging all parties in working towards a healthier Baltic Sea.

For example, mutually beneficial actions could involve developing instruments within the agricultural subsidy mechanism in a way, that the structure and policy of the system would motivate farmers to engage in more environmentally friendly production, especially in the key areas with the greatest impact on the Baltic Sea. Under this scheme, the same amount of aid could be divided in different ways than now and be subject to authorization. This measure could therefore affect the allocation criteria of environmental compensation, not the amount of compensation itself.

Eutrophication of the Baltic Sea, as well as the impacts of climate change, are still on the focus of wide scientific research. As new data is available, information should be easily accessible to decision-makers around the Baltic Sea region. Future-oriented, sustainable decision-making would require up-to-date results of the situation of the sea and the causes of eutrophication.

REFERENCES

Literature:

Bailey, K. (1994) *Typologies and Taxonomies, An Introduction to Classification Techniques.* Sage Publications, Thousand Oaks.

Dator, J. (2002) *Advancing Futures: Futures Studies in Higher Education.* Westport, Connecticut: Praeger.

Hanley, N. – **Shogren**, J. F. – **White**, B. (2001) *Introduction to Environmental Economics.* Oxford University Press Inc., New York.

Kuusi, O. – **Bergman**, T. – **Salminen**, H. (toim.) (2013) *Miten tutkimme tulevaisuuksia?* Tulevaisuuden tutkimuksen seura ry. Sastamala.

Leppäranta, M. – Myrberg, K. (2009) *Physical Oceanography of the Baltic Sea.* Springer-Verlag Berlin and Heidelberg GmbH & Co. KG.

Wilenius, M. (2015) *Tulevaisuuskirja, Metodi seuraavan aikakauden ymmärtämiseen*. Otava.

Zwicky, F. (1969) *Discovery, Invention, Research through the Morphological Approach.* The Macmillan, New York.

Articles:

Adema, K. – **Roehl**, W. (2010) *Environmental scanning the future of event design.* International Journal of Hospitality Management, Vol 29, Issue 2, 199–207.

Álvarez, A. – **Toja**, P. (2018) *From our perspective: An informal survey on the application of General Morphological Analysis in the private sector.* Technological Forecasting and Social Change, Vol 126, 182–185.

Amer, M. – **Daim**, T. – **Jetter** A. (2013) *A review of scenario planning.* Futures, 23–40.

Bonsdorff, E. – **Blomqvist**, E.M. – **Mattila**, J. – **Norkko**, A. (1997) *Coastal Eutrophication: Causes, Consequences and Perspectives in the Archipelago Areas of the Northern Baltic Sea.* Estuarine, Coastal and Shelf Science 44 (Supplement A), 63–72.

Cederwall, H. – **Elmgren**, R. (1990) *Biological effects of eutrophication in the Baltic Sea, particularly the coastal zone.* AMBIO - Journal of Human Environment, Vol. 19 No. 3. 109–112.

Czajkowski, M. – **Meyerhoff**, J. – **Alemu**, M. – **Dahlbo**, K. – **Fleming**, V. – **Hasler**, B. – **Hyytiäinen**, K. – **Karloseva**, A. (2012) *Benefits of meeting the Baltic Sea nutrient reduction targets - Combining ecological modelling and contingent valuation in the nine littoral states.* MTT Discussion Papers 1.

Duczynski, G. (2017) *Morphological analysis as an aid to organizational design and transformation*. Futures. Vol 86, Feb 2017, 36–43.

Johansen, I. (2018) *Scenario modelling with morphological analysis.* Technological Forecasting and Social Change, Vol 126, 116–125.

Kautskyl, N. – **Kautskyl**, H. – **Kautskyl** U. – **Waern**, M. (1986) *Decreased depth pen etration of Fucus vesiculosus since the 1940's indicates eutrophication of the Baltic Sea*. Marine Ecology Progress Series. Vol. 28: 1–8.

Könnölä, T. – **Salo**, A. – **Cristiano**, C. – **Vicente**, C. – **Vilkkumaa**, E. (2012) *Facing the future: Scanning, synthesizing and sense-making in horizon scanning.* Science and Public Policy, Vol 39, 222–231.

Lipscomb, R. (2011) *Identifying Opportunities: A Report on the 2010 American Die-*

tetic Association Environmental Scan on Restaurant Menu Labeling. Journal of the American Dietetic Association, Vol 111, Issue 5, S36–S41.

Lord, S. – **Helfgott**, A. – **Vervoort**, J. (2016) *Choosing diverse sets of plausible scenarios in multidimensional exploratory futures techniques.* Futures, Vol 77, 11–27.

Lyytimäki, J. (2012) *The environment in the headlines, Newspaper coverage of climate change and eutrophication in Finland.* MONOGRAPHS of the Boreal Environment Research No. 42: 2012.

McCrackin, M.L. – **Jones**, H.P. – **Jones**, P.C. – **Moreno-Mateos**, D. (2016) *Recovery of lakes and coastal marine ecosystems fromeutrophication: A global meta-analysis*. Limnology and Oceanography, No. 62: 2017, 507-518.

Miles, I. – **Saritas**, O. (2012) *The depth of the horizon: searching, scanning and widening horizons.* Foresight, Vol 14, Issue 6, 530–545.

Oinonen S, – **Hyytiäinen** K, – **Ahlvik** L, – **Laamanen** M, – **Lehtoranta** V, – **Salojärvi** J, et al. (2016) *Cost-Effective Marine Protection - A Pragmatic Approach.* PLoS ONE 11(1): e0147085. <https://doi. org/10.1371/journal.pone.0147085> retrieved 4.8.2016

Omran, A. – **Khorshid**, M. (2014) *Intelligent Environmental Scanning Approach, A Case Study: The Egyptian Wheat Crop Production.* IERI Procedia, Vol 7, 28–34.

Ritchey, T. (2018) *General morphological analysis as a basic scientific modelling method*. Technological Forecasting and Social Change, Vol 126, 81–91.

Rosenberg, R. (1985) *Eutrophication – The future marine coastal nuisance?* Marine Pollution Bulletin, Vol. 16, Issue 6, 227–231.

Rowe, E. - **Wright**, G. – **Derbyshire**, J. (2017) *Enhancing horizon scanning by utilize-*

ing pre-developed scenarios: Analysis of current practice and specification of a process improvement to aid the identification of important 'weak signals'. Technological Forecasting and Social Change, Vol 125, 224–235.

Thompson, J. – **Martin**, F. (2010) *Strategic Management: Awareness & Change.* 6th ed. Cengage Learning EMEA, p. 86–88

Toivonen, S. – **Viitanen**, K. (2016) *Environmental scanning and futures wheels as tools to analyze the possible future themes of the commercial real estate market.* Land Use Policy, Vol 52, 51–61.

Electronic sources:

Baltic Eye Policy Brief (2016) *Nutrient Recycling in agriculture – for a cleaner Baltic Sea*. Baltic Sea Centre, Stockholm University. <http://www.su.se/polopoly_fs/1.301618.1476346407!/menu/standard/file/PBgödselENGwebb.pdf>, retrieved 8.11.2018.

Baltic Marine Environment Bibliography (2015) *Environmental Conditions in the Baltic Sea Region* <http://www.baltic.vtt.fi/demo/balful.html>, retrieved 29.11.2015.

BSAP (2018) Implementation of the Baltic Sea Action Plan <http://www.helcom.fi/Lists/Publications/Implementation%20of%20the%20BSAP%202018.pdf>, retrieved 20.11.2018.

Club of Rome (2015) *The Circular Economy and Benefits for Society.* <https://www.clubofrome.org/wp-content/uploads/2016/03/The-Circular-Economy-and-Benefits-for-Society.pdf>, retrieved 9.11.2018.

Ellen McArthur Foundation (2013) *Towards the Circular Economy – Economic and business rationale for accelerated transition.*

<https://www.ellenmacarthurfoundation.org/assets/downloads/publications/Ellen-MacArthur-Foundation-Towards-the-Circular-Economy-vol.1.pdf>, retrieved 9.11.2018.

EPRS (2016) European Parliament Research Service. Circular Economy Package, Four legislative proposals on waste. <http://www.europarl.europa.eu/EPRS/EPRS-Briefing-573936-Circular-economy-package-FINAL.pdf>, retrieved 26.11.2018.

EU Marine Strategy (2008) European Union Marine Strategy Framework Directive. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0056>, retrieved 26.11.2018.

European Commission (2017) *Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the implementation of the Circular Economy Action Plan* <http://ec.europa.eu/environment/circular-economy/implementation_report.pdf>, retrieved 8.11.2018.

European Court of Auditors (ECA) (2016) *Special Report: Combating eutrophication in the Baltic Sea: further and more effective action needed* (pursuant to Article 287(4), second subparagraph, TFEU) <http://www.eca.europa.eu/Lists/ECADocuments/SR16_03/SR_BALTIC_EN.pdf> retrieved 4.8.2016.

HELCOM (2018) *Draft strategic plan for the BSAP update*. < https://portal.helcom.fi/meetings/HOD%2054-2018-535/MeetingDocuments/3-4-Rev2%20Draft%20strategic%20plan%20for%20the%20BSAP%20update.pdf>, retrieved 26.11.2018.

HELCOM (2015) *Updated Fifth Baltic Sea pollution load compilation (PLC-5.5).* Baltic Sea Environment Proceedings No. 145 <http://www.helcom.fi/Lists/Publications/BSEP145_Lowres.pdf>, retrieved 30.11.2015.

HELCOM (2018) Sources and pathways of nutrients to the Baltic Sea, HELCOM PLC-

6, Baltic Sea Environment Proceedings No. 153: 2018 <http://www.helcom.fi/Lists/Publications/BSEP153.pdf>, retrieved 20.11.2018.

Kaal, E. – Olesk, A. – Tampere, K. (2015) *Local actiors and the Baltic Sea 1: Attitudes towards water protection among the population of Baltic countries – a questionnaire study*. Tallinn University. <http://www.citywater.fi/files/2014/09/Local-Actors-and-the-Baltic-Sea-1.pdf>, retrieved 9.11.2018.

Millennium Project Appendix B, <http://107.22.164.43/millennium/applic-appb.html>, retrieved 8.4.2018.

Ministerial Declaration (2018) *Declaration of the Ministers of the Environment of the Baltic Coastal Countries and the EU Environment Commissioner*, HELCOM Brussels Declaration 2018 <http://www.helcom.fi/Documents/HELCOM%20at%20work/HELCOM%20Brussels%20Ministerial%20Declaration.pdf>, retrieved 20.11.2018.

Ministry of the Environment (2015) *The Baltic Sea and Marine Protection* <http://www.ym.fi/en-US/Nature/The_Baltic_Sea_and_marine_protection>, retrieved 26.11.2015.

Sitra (2015) The economic value and opportunities of nutrient cycling for Finland. <https://media.sitra.fi/2017/02/28142456/Selvityksia104.pdf>, retrieved 4.8.2016.

Strategic Program of Prime Minister Juha Sipilä's Government (2015) *Finland, a land of solutions.* Government Publications 12/2015. <http://valtioneuvosto.fi/en/sipila/government-programme>, retrieved 29.11.2015.

Swedish Environmental Protection Agency (2010) *Baltic Survey – a study in the Baltic Sea countries of public attitudes and use of the sea*.

<http://www.stockholmresilience.org/download/18.5004bd9712b572e3de6800014166/1459560307173/BalticSurvey%20Report%20978-91-620-6382-5webb.pdf>, retrieved 9.11.2018.

Web sites:

Agency of Rural Affairs
<http://www.mavi.fi/en/Pages/default.aspx>, retrieved 26.11.2018.

Aquabest
<http://eu.baltic.net/Project_Database.5308.html?contentid=72&contentaction=single>, retrieved 8.11.2018

Baltic Eye, Baltic Sea Centre, Stockholm University
<https://balticeye.org/en/about/>, retrieved 8.11.2018

Bonus Return
<https://bonusreturn.com/about/>, retrieved 8.11.2018

BSAG, Baltic Sea Action Group, Nurtien Cycling
<https://www.bsag.fi/en/baltic-sea/nutrient-cycling/>, retrieved 27.11.2018.

BSPC, The Baltic Sea Parliamentary Conference
<http://www.bspc.net/about-bspc/the-baltic-sea-parliamentary-conference/>, retrieved 24.11.2018

BSPC, Mariehamn Conference (2018)
<http://www.bspc.net/annual-conferences/the-27th-baltic-sea-parlimentary-conference-mariehamn-26-28-august-2018/>, retrieved 20.11.2018.

EU Circular Economy Package (2018) *Circular Economy – Closing the Loop*
<http://ec.europa.eu/environment/circular-economy/index_en.htm>, retrieved 8.11.2018.

EU Law (2018) Regulations, Directives and other acts. <https://europa.eu/european-union/eu-law/legal-acts_en>, retrieved 26.11.2018.

EUSBSR (2018) EU Strategy for the Baltic Sea Region. <https://www.balticsea-region-strategy.eu/about>, retrieved 26.11.2018.

HELCOM, *Baltic Sea Trends* <http://helcom.fi/baltic-sea-trends/eutrophication/>, retrieved 30.11.2015

HELCOM, *State of the Baltic Sea*, Second HELCOM holistic assessment 2011-2016 <http://stateofthebalticsea.helcom.fi/pressures-and-their-status/eutrophication/>, retrieved 8.11.2018.

HELCOM (2018) *Agreement reached on next steps for a healthy Baltic Sea*, Press release 06.3.2018 <http://www.helcom.fi/news/Pages/HELCOM-agreement-reached-on-next-steps-for-a-healthy-Baltic-Sea.aspx>, retrieved 20.11.2018.

John Nurminen Foundation (2018) *NutriTrade.* <https://www.johnnurmisensaatio.fi/en/clean-baltic-sea-projects/nutritrade/>, retrieved 27.11.2018.

Jätevesiopas (2018) *Jätevedenkäsittelyn lainsäädäntö.* <https://vesiensuojelu.fi/jatevesi/etusivu/lainsaadanto-pahkinankuoressa/>, retrieved 26.11.2018.

KK 113/2018 vp, Written question. <https://www.eduskunta.fi/FI/vaski/Kysymys/Sivut/KK_113+2018.aspx>, retrieved 20.11.2018.

KKV 113/2018 vp, Answer to written question. <https://www.eduskunta.fi/FI/vaski/Kysymys/Documents/KKV_113+2018.pdf>, retrieved 20.11.2018.

LUKE (2018) The benefits of protecting the Baltic Sea vary by country – the costs of nutrient abatement could be shared. <https://www.luke.fi/en/news/the-costs-of-nutrient-abatement-could-be-shared/>, retrieved 26.11.2018.

McKinsey (2015) Europe's circular-economy opportunity. <https://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/europes-circular-economy-opportunity>, retrieved 9.11.2018

NDEP, Northern Dimension Environmental Partnership <https://ndep.org/about/overview/what-we-do/>, retrieved 24.11.2018.

Niinistö, S. The President of the Republic of Finland, speech (27.8.2018) at the opening of the 27th Baltic Sea Parlimentary Conference in Mariehamn <http://www.tpk.fi/public/default.aspx?contentid=377702&nodeid=44810&contentlan=1&culture=fi-FI>, retrieved 20.11.2018.

Prime Minister's Office, Finland. Bulletin, 384/2018. <https://vnk.fi/artikkeli/-/asset_publisher/osaaminen-tyollisyys-kasvu-ja-ruoka-paaosissa-vuoden-2019-budjettiesityksessa>, retrieved 20.11.2018.

SYKE (2015) *Ilmaston lämpeneminen muuttaa merkittävästi Itämeren ominaispiirteitä.* <http://www.syke.fi/fi-FI/Ajankohtaista/Tiedotteet/Ilmaston_lampeneminen_muuttaa_merkittava(33448)>, retrieved 26.11.2018.

SYKE (2018) *Nutrient load into the Baltic Sea continues to be too high, and global warming also increases the risk of blue-green algae blooms* <http://www.syke.fi/en-US/Current/Nutrient_load_into_the_Baltic_Sea_contin(47430)>, retrieved 8.11.2018.

Other:

Millennium Project CD-ROM (2009) Futures Research Methodology 3.0. edition. The Millennium Project.